In The

Supreme Court of the United States

October Term, 1960

No. 315 and 454

Power Reactor Development Company, *Petitioner*,

v.

International Union of Electrical, Radio and Machine Workers, AFL-CIO, et al., *Respondents*.

United States of America and Atomic Energy Commission, *Petitioners*,

v.

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On Writs of Certiorari to the United States Court of Appeals For the District of Columbia Circuit

BRIEF OF ADOLPH J. ACKERMAN, AMICUS CURIAE

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STATEMENT OF POSITION

This brief is respectfully submitted to the Supreme Court of the United States by Adolph J. Ackerman, *amicus curiae*, an American citizen residing in the City of Madison, Wisconsin. He is engaged in the practice of professional engineering in the field of electric power and water resources development. This includes the economic appraisal of proposed programs of development and the general planning and site selection for new power plants. He received a Bachelor of Science degree in electrical enginering from the University of Wisconsin in 1926 and a degree of Civil Engineer from the same University in 1935. The State of Wisconsin granted him a license to practice engineering in 1953, and he is also licensed to practice in various other States; he began his formal professional practice in 1937 under a license granted by the State of Tennessee. Part of his time is devoted to the educational field in professional engineering as a Visiting Professor and as a member of a Visiting Committee at two leading universities. He has also served on various committees of National Engineering Societies which have been concerned with the practical application of atomic energy.

REASONS PROMPTING THE SUBMISSION OF AMICUS CURIAE BRIEF

The issues before the Court in this proceeding are of grave importance in the application of the new science of atomic energy for the generation of electricity, and involve heavy responsibilities concerning the health and safety of the general public. Beyond the questions which have been defined in terms of embryonic law and emerging regulatory principles, is the fundamental question whether a potential hazard of unprecedented magnitude shall be introduced in an area where a large population would be exposed to it. The Court's decision in this case is bound to have direct and far-reaching influence on the progress and application of atomic power and on the related questions of public health and safety.

The selection of a site for an atomic power plant is not governed by rules of law, but calls for the application of expert judgment by professional engineers. It is a problem involving great responsibility and technical complexity on which the available knowledge is relatively limited.

Although the criteria for the selection of a site for a *conventional* type of power plant correspond to well established principles based on the operating experiences of many similar power plants in all parts of the country, the introduction of *atomic energy* for the generation of electricity has brought with it new criteria for site selection. It will be shown that some of the criteria employed in the selection of the site for the atomic power plant in the case before this Court violate the traditional principles of responsibility which the engineering profession is expected to

observe. The basic issue, therefore, although it here concerns specific parties, is of deep concern—now and for all future time—to professional engineers.

It is the belief of amicus curiae that an exposition on the responsibilities of the professional engineer in relationship to the tremendous perils involved in the application of a new science will help to clarify the fundamental questions before this Court. This brief, therefore, represents an effort on the part of a professional engineer to meet his obligations in serving the public interest.

Questions Relating to the Project

The questions before this Court relate to an atomic power plant (Enrico Fermi) currently under construction by the petitioner, Power Reactor Development Company (PRDC), at a site known as Lagoona Beach, some 29 miles southwest of the City of Detroit, Michigan. Although a specific project is here involved, the issues are of overriding importance and applicable to all atomic power developments, whether owned privately or by public bodies.

Why is there a conflict? This question is discussed in considerable detail in the present brief, but the following basic factors are elements in the conflict:

1. In the selection of this power plant site, the normal influences of professional engineering responsibility for the protection of the public—and the ethical obligations of the engineering profession—have been denied their normal freedom of action.

2. Once the atomic power plant goes into operation, the surrounding population (although generally unaware

of its position) would be living in the shadow of a potential disaster of unprecedented magnitude. For this reason part of the population in the vicinity is seeking relief from the Court to prevent this project becoming an operating hazard.

3. In the event of a major accident or failure of the atomic energy unit, most of the resulting cost of the disaster would fall on the taxpayers of the country. At present they are generally unaware of this potential new burden.

4. In applying for a license for this new power plant (which was approved by the Atomic Energy Commission) some unusual procedures were introduced.

a. A first license has authorized only the *financing* and *construction* of the power plant, on the strength that this involves no atomic operating hazards; however, the magnitude of such potential hazards was recognized.

b. A second license for the *operation* of the power plant is to be considered some years later, after the large capital investment has been made. This sequence may create an element of pressure for gaining approval from those who must finally pass on questions of safety in the operation of this plant.

QUESTIONS BEFORE THE COURT

1. Does the Atomic Energy Act of 1954 require the Commission to withhold approval of a site for an atomic power reactor near a populous area, unless the Commission finds that there are "compelling reasons" for approving such location?

2. Before granting a permit for the *construction* of a developmental atomic power reactor, is the Commission required, under the Atomic Energy Act of 1954, to determine that the proposed reactor can also be *operated* at a proposed location without undue risk to the health and safety of the public?

SUMMARY OF ARGUMENT

1. The fundamental question is this: In the experimental or commercial application of a new scientific discovery of an extremely dangerous type, is adequate protection being provided for the health and safety of the public?

2. In the normal course of our historical development the health and safety of the public have been safeguarded by two basic influences which have grown up as intrinsic features of our social and economic system and of our Constitutional form of government. The first influence is a broad structure of law which has been enacted at the local, state and national levels of government; this is administered by selected public officials and is upheld by a distinguished profession in law, as well as by an independent judiciary at each of these levels. The second influence is an equally broad structure (at the local, state and national levels) of trained specialists in the professions of medicine and engineering; these carry out their responsibilities within the law, but with the added obligation of observing the self-imposed disciplines and ethical standards of their professions. Both of these influences are the product of centuries of experience in human relations and mutual confidence.

3. The new scientific discovery of atomic energy is of fundamental importance and far-reaching influence throughout the world. However, its complexities are understood by an extremely small number of scientists; furthermore its application in the useful service of man (for the production of electricity) is generally regarded as being only in the experimental stage.

4. The case before the Court raises some basic questions regarding the application of atomic science under a very limited structure of new law and in conflict with the established disciplines and ethical standards of the engineering profession. This is the first case of its kind before this Court concerning the administration of such law and the final decision will have an important bearing on the future trend in the application of this new science.

5. An objective of this brief is to demonstrate that the present issues before the Court have developed out of various current deficiencies in our social and economic system, and out of the abandonment of the normal sense of responsibility in the application of a hazardous new science.

6. The application of atomic science for the production of electricity ("atomic power") has developed under unique circumstances as a result of an historical coincidence. Scientists succeeded in making the first experimental demonstration of nuclear fission in the same year that World War II began. The destructive potentials of nuclear fission were soon recognized, and this led to the rapid development of the atomic bomb. All of this work was done under governmental control and in strictest wartime secrecy. With the end of the war came a strong desire to apply atomic energy to beneficial uses and, as a first step, Congress passed the Atomic Energy Act of 1946. However, this Act established atomic energy as a government monopoly and subjected the research and development work on such applications to full governmental control. Some eight years later new legislation was enacted (in 1954) which relaxed the governmental monopoly features—but did not eliminate them.

7. In general, the development of atomic power has taken place in a direction opposite to that which has occurred in the production of electric power from coal, oil or falling water. These conventional power sources have grown up step by step through a multi-centered process of development, and under exacting standards of design which carry the approval of the engineering profession. Governmental controls have been devised as the need developed. In contrast, the current development of atomic power is taking place in reverse sequence, starting with the status of a government monopoly. This is interfering with the application of the established disciplines and responsibilities of the engineering profession for safeguarding the public health and safety.

8. In the case of the atomic power project before this Court, if the location of the project had been established within the normal disciplines and responsibilities of the engineering profession, the present site could not have been approved. When an Advisory Committee originally reviewed the proposal, it found the available information insufficient to give assurance that the reactor could be operated at this site without public hazard. Unfortunately, the opinion of this Committee did not prevail.

9. The historical development of law at the state and local levels which, in essence, holds individuals and companies responsible for any damage which their activities might inflict on the public, has produced nationwide standards of public safety. As a concurrent influence, the insurance industry has demanded high standards of safety and the application of sound engineering practices as a prerequisite to writing insurance against any liability which

might arise. In the new and startling developments of atomic power the insurance industry was confronted with many new problems and potential hazards of unknown magnitude. Estimates released by the Atomic Energy Commission revealed that property damage from the failure of an atomic power plant could amount to more than $2,000,000,000, that fatalities could number in the thousands, and injuries in the tens of thousands. The insurance industry sought to serve this new area of risk-taking, but found it beyond its capabilities. The various companies finally pooled their resources and agreed to provide up to $60,000,000 in public liability insurance for an atomic power plant. Although this was an unprecedented amount for the American insurance industry, it fell far short of protecting the manufacturers and the agencies which might engage in the production of atomic power.

10. It must be viewed with regret that this problem was resolved by placing on the Federal Government and, thus, on the nation's taxpayers, the liability for any damages (in excess of the amounts covered by the insurance companies) which might result from an atomic power plant disaster. This did not, of course, eliminate the hazard; it only relieved the agencies which might engage in the development or production of atomic power of the great financial responsibilities in the event of a disaster. This is the situation which applies today to all large atomic power projects.

11. The developmental and design programs of the past 15 years, together with operating failures which have occurred on small scale "pilot" atomic power plants, have confirmed the terrifying potentials of disaster which may be associated with such power plants.

12. It is generally recognized that the conventional energy resources of coal, oil and falling water are more than adequate to meet the foreseeable power needs for the remainder of this century. This removes the concept of urgency for generating electricity from "atomic fuels," or of taking chances which involve potentially disastrous consequences (no matter how remote they may be "believed" to be) on the grounds that by so doing the development of atomic power would be "accelerated."

13. The idea that history tends to repeat itself may find some confirmation in the present case. In 1929 the late Lord Chief Justice of England, Hewart of Bury, wrote in eloquent terms about the emergence of a new system of law. He called attention to the trend (in this age of technology) of transferring great responsibilities, by legislation, to new administrative agencies; these, in turn, are given wide range of authority to establish admi strative controls and regulations which eventually become administrative laws." This, he warned, may eventually lead to "administrative lawlessness." Such a trend, obviously, would contain hidden dangers to our Constitutional system of government and to the Rule of Law, as well as to the independence of our established system of justice.

14. The factors and relevant issues involved in the present case are much broader and far-reaching than the simple question whether a specific atomic power reactor should or should not have been constructed at a particular site. The Court's decision in this case could have a far-reaching influence in preventing the abandonment of principle for expediency.

ARGUMENT

I. OBJECTIVE OF THIS BRIEF

The objective of this brief is to demonstrate that:

I. The present issues before the Court have developed out of one or more of the following deficiencies:

(a) Circumvention of the responsibilities of the independent professional engineer;

(b) harmful exploitation of engineering responsibilities;

(c) harmful exploitation of public confidence in the engineering profession;

(d) failure of leaders in the engineering societies to defend the position and responsibilities of the profession;

(e) failure of leaders in higher education and in scientific societies to provide effective interpretation of this new science to public authorities and to the professions;

(f) overzealousness and uncontrolled pressures to manufacture and sell new types of atomic equipment;

(g) undisciplined efforts to excel in new technological achievements;

(h) abandonment of management and corporate responsibilities (as a consequence of special legislation), and transfer of such responsibilities to the Federal Government;

(i) unwillingness or failure on the part of those in high governmental authority to seek or accept responsible engineering advice;

(j) a combination of these deficiencies which may be summarized as "a situation peculiar to these times of declining self-discipline and morality."

II. These deficiencies have led to a situation which is harmful to the public interest and the national welfare. The various areas of responsibility which are involved in the development and practical application of the new science of atomic energy will be reviewed in greater detail.

II. A CONFLICT OF RESPONSIBILITIES

A factor contributing to the present case is the lack of common understanding regarding the basic difference in responsibilities as between scientists and engineers. As a matter of fact, in recent decades there has emerged such a confusing concept of these two professions that the terms "scientist" and "engineer" are at times used interchangeably or in combination as "engineer-scientist." Such a confused use of these designations is harmful to public safety as well as to national policy.

Technology During World War II

World War II was largely a terrifying struggle in the application of modern engineering and science; in the course of this struggle, our nation mobilized its resources of engineering and of science into a single collective "force of technology."

The end of the war left the world disrupted at all levels of civilized endeavor. From this chaos new levels of authority and responsibility had to be established either through the exercise of dictatorial powers or by the slower processes of democracy.

In this historical transition from war to peace the normal areas of responsibility as between the scientist and the engineer have *not* been re-established on a basis which would best serve the national welfare. As a matter of fact, the traditional concepts in such matters have become obscured within both of these great professions, and there is little evidence that their members have the resources or the will to redefine their respective areas of responsibility. This must be regarded as a basic defect in our national posture. Furthermore, it can be shown to be a factor in the conflict which this Court has been asked to resolve.

The Decisive Powers of Modern Science

Modern science has demonstrated that it can open the way to a golden age if it is developed in freedom for the benefit of mankind. However, as some of the basic forces of science are becoming all-powerful, modern science is also providing the means for a "reign of terror" under the threat of "total destruction" if these forces are concentrated in the hands of the few and directed toward selfish or ruthless ends. The history of mankind has been a story of being buffetted by the forces of good and evil. Today, more than ever, the choice of direction for the future of man depends upon the wisdom of great decisions involving the application of scientific principles.

One of the great truths of our technological age has been stated in these words: "Modern science is the blessing and curse of our age; it holds decisive powers for good and for evil." Today the ability of man to govern himself—to control his own destiny—has been seriously challenged.

Professional engineers, working in freedom, have a primary responsibility of making plain to their governments, their fellow citizens, indeed to all mankind, the true nature of this situation and of the awesome choices it presents. In meeting this obligation it is their duty to give overriding consideration to the public safety and to the national welfare. This is a moral responsibility—a moral responsibility for the direction taken by our civilization and for the sort of lives our children's children shall inherit.

Definitions of "Scientist" and "Engineer"

There is as much difference between the roles of the scientist and of the engineer as there is between night and day. Specifically, the scientist makes things known and the engineer makes things work. A world-renowned scientist has identified the fundamental characteristic of a scientist by saying that "the most common activity in which a scientist finds himself is to make mistakes, recognize them and correct them."[1] In other words, out of the repeated failures in a research project the skilled scientist eventually brings forth a new discovery. This is the ultimate objective of a scientist. His training has prepared him to become an expert in experimenting; however, no matter how great the

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[1] "What Is Scientific Education?" Address presented at Marquette University, Milwaukee, Wisconsin, May 20, 1959. Unpublished transcript from Marquette University.

public esteem may become as a result of his discovery, he has not become vested, overnight, with any peculiar authority to decide on its use.

Too many scientists, if they succumb in later years to the temptation of assuming administrative or governmental authority, are prone to experiment also in public affairs and to commit monumental errors.

In contrast, the engineer is trained and disciplined *not* to make mistakes. He commits himself to the severe discipline and moral obligation of applying scientific principles within established rules of public safety and with due regard to economy and the national welfare. Within these severe demands on personal integrity the professional engineer undertakes to synthesize a wide range of technical, legal, financial and social requirements and to function as a planner, designer, builder or administrator. However, it must be remembered that the *application* of scientific discoveries remains the task of fallible men and, once the engineer has made a serious mistake, his professional standing may be damaged or permanently ended.

The engineer's conservatism and sense of responsibility in the practical application of scientific discoveries has, in the past, taxed the patience of many a scientist. If left to his own devices and to his "privilege of making mistakes," the scientist is inclined to adopt "short-cuts" in approaching his objectives, and to by-pass the moderating influence and professional disciplines of the engineer. A statement by a noted scientist regarding the post-war development of atomic energy is an example of this philosophy: "The simultaneous pursuit of programs of research,

development and construction has become standard in the fast-moving field of atomic energy."

In recent decades the distinctive functions and responsibilities of the professional engineer have become so obscured that a detailed exposition is needed here to identify some of the important elements, particularly as they apply to the conflict before this Court.

The Role of the Professional Engineer

The purpose of engineering is to serve mankind; this service is achieved through the individual and personal responsibility of the professional engineer. His professional services demand every bit as much personal attention and responsibility as that of a surgeon performing a highly critical operation.

Although a professional engineer may rise to a high position of success and public recognition for his achievements, there is, unfortunately, a general lack of understanding and appreciation of the great risks and personal responsibilities which he assumes in his work. Too often this part of the engineer's function comes to public attention only in the event of a failure. Numerous failures have occurred in the past, generally with tragic consequences to the engineer.

As an example, a disastrous failure in engineering occurred on the night of March 12, 1928 when the St. Francis Dam in California broke, resulting in 700 houses being swept away and a loss of 450 lives. The Chief Engineer who was responsible for the design and construction of this

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Brief For the Petitioners, United States and Atomic Energy Commission, No. 454, This Term, p. 45.

dam, Mr. William Mulholland, after 40 years of leadership in his profession, declared: "Don't blame anybody else. Whatever fault there was in this job, put it on me. If there were any errors in judgment—and it's human to make mistakes—the error was mine. I envy only those who are dead."[3]

There is no substitute for such a concept of responsibility in engineering. This sense of personal responsibility on the part of each engineer is particularly important in areas of general public service, such as electric power supply or municipal water supply. Adequate protection of the public health and safety calls for a nationwide resource of engineers who are dedicated to the practice of their profession in accordance with established disciplines and ethics. Such engineers have the obligation of building and operating public and private facilities of all types which conform to approved standards of design and economy and which contribute to the advancement of the nation within our Constitutional form of government and within the established rules of law.

It is in these terms that the engineering profession is a vital national asset whose members are skilled in applying scientific discoveries for the benefit and well-being of the public. Unwarranted political influence or encroachment on their responsibilities and authority would clearly be a violation of public trust.

Thaddeus Merriman, the former Chief Engineer of the Board of Water Supply for the City of New York has summarized the professional engineer's obligations as follows:

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[3] **Western Construction News**, Quoted in editorial, San Francisco, California, Volume III, Number 7, p. 223, April 10, 1928.

". . . [The engineer's] duty does not lie only in saving a maximum of his client's money. It demands absolutely that the public be afforded a maximum of safety. If the client is unwilling or unable to pay for that maximum then he should not have [his project]. And what is true in the case of a private client is just as importantly true when the engineer acts for public authority —he must still protect the public—no one else can perform that function."[1]

The sense of responsibility of professional engineers, together with the confidence of the public in the engineering profession, comprise a rich heritage which stands as the primary bulwark for the protection of the public in the application of science and technology. This confidence must be maintained and merited in the future as an essential feature of a free society. The public has a right to expect absolute intellectual honesty. Herbert Hoover has stated most precisely that "technology without intellectual honesty will not work."

The Importance of Freedom in Engineering

It has been well stated that: "Without engineering, freedom could bring you a happier but not an easier life. Without freedom, dictators could use engineering to enslave you."[2]

Without freedom the professional engineer is unable to meet his ethical obligations in the practice of his technical skills, and without freedom, he is unable to serve his client's and the public's interest to best advantage.

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[1] Merriman, Thaddeus. "Naught But the Best." **Civil Engineering**, December 1939. pp. 701-702.

[2] Inscription on Museum of Science and Industry, Chicago, Illinois.

A noted engineer has described the obligations of the professional engineer in these terms:

> "Since engineering is a profession which affects the material basis of everyone's life, there is almost always an unconsulted third party involved in any contract between the engineer and those who employ him, and that is the country, the people as a whole. These, too, are the engineer's clients, albeit involuntarily. Engineering ethics ought, therefore, to safeguard those interests most carefully. Knowing more than the public about the effects his work will have, the engineer ought to consider himself an officer of the court and keep the general interest always in mind.
>
> "Service ceases to be professional if it has in any way been dictated by the client or employer. Professional independence is not a special privilege but rather an inner necessity for the true professional man and a safeguard for his employers and the general public. Without it he negates everything that makes him a professional person and he becomes at best a routine technician or a hired hand, at worst, a hack.'"

In recent years decisions have been made in areas of science—areas in which even the well educated man is often a stranger—which affect the lives and welfare of many people and of entire nations. However, if a free society is to remain free, it must demand the application of scientific discoveries under the dedicated responsibility of professional engineers working in freedom.

Responsibilities and Limitations in Engineering Design

The predominant influences of science and of engineering have appeared on the world's scene within the past cen-

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[1] "The Meaning of Your Profession." 104 Cong. Rec. 18349, 18351.

tury, which, in terms of history, is a relatively short time. The turn of the century marks the beginning of the revolutionary period of modern science, and it is still within the span of our lifetimes that engineers have become a vital factor in the American industrial scene. Not long ago industrial development depended largely upon mechanical inventiveness. With the advent of modern science have come discoveries and explanations which are more fundamental. Yet, such fundamentals do not explain what is engineeringly sound.

With the advent of a new science the engineer cannot minimize or ignore a potential hazard on the grounds that all of the scientific data necessary for a complete understanding of the hazard are not available. In fact, it is precisely in such areas where the professional skills and judgment of the engineer take on added importance as a moderating influence.

Recognizing that error is an inherent factor in all human activity, the professional engineer applies his technical knowledge and professional disciplines preponderantly on the side of safety. One of his most important tools is the "factor of safety." For example, the stability of a dam may have a factor of safety of 2; this means that before such a structure would fail, the supported load would have to be twice the assumed or predictable load for which the structure was designed. Thus the factor of safety compensates for unexpected or unpredictable greater loads in the coming decades, as well as for possible deterioration with time.

The factor of safety has also been called the "factor of ignorance"—as an acknowledgment of the inability to predict all of the events which a structure may experience

in the future. Similar criteria apply in all engineering but, in spite of all the applied skill and precautions, failures continue to occur for many reasons which could not be anticipated in the original design.

There is no such thing as foolproof design or operation of a power plant. The possibility of an accident or disaster is ever present and the biggest disasters have been the most incredible. Generally, out of a painstaking investigation of a disaster a complex chain of "incredible" circumstances has emerged to explain the cause.

Modern history records numerous disasters in engineering and technology, with tragic loss of life, such as the sinking of the "unsinkable" Titanic, the conflagration in the "fireproof" Iroquois Theater, the explosion of gas in the new school of New London, Texas, the collision of two large passenger airplanes over the vast expanse of the Grand Canyon region. Many others could be cited. In every case there was a great loss of life and property. And in every case the odds against the occurrence were undoubtedly considered to be fantastically large. Nonetheless, they did occur and there is no reason to believe that others will not occur in the future.

Separation of Responsibilities of Engineers

The personal responsibilities of a professional engineer are at times so great that it is in the best interest of all concerned to subdivide and isolate the main areas of engineering responsibility, and to adopt a system of checks and balances similar to the system of our republican form of government.

For example, a project may be undertaken by a corporation whose chief engineer has the primary responsibility of interpreting the particular objectives as laid down by his directors. (This would correspond to the legislative branch of our government.)

A second area of responsibility is undertaken by a separate consulting engineer and his firm which create the designs within economic limits and under approved factors of safety; this firm would also supervise the interpretation of its designs during the period of construction and during the manufacture of the required machinery and materials. (This would correspond to the administrative branch of our government.)

A third area of engineering responsibility rests on the shoulders of the chief engineer for the contractor who undertakes the construction of the project for a specific price. His primary obligation is to devise the most efficient and economical construction techniques in full compliance with the plans and specifications. (This would correspond to a second area within the administrative branch of government.)

A fourth area of engineering responsibility is assigned to an independent consulting engineer (or to an independent board of consulting engineers), with the overriding duty of looking after the owner's and the public's best interests, by acting as an observer or technical auditor during the planning, design, financing and construction of the project, and in reviewing issues which may run into conflict. (This would correspond to the judicial branch of the government.)

Such a system of coordinated professional controls, functioning freely, but without compromise on important professional responsibilities in each of the four areas has, in the past, produced notable engineering achievements; more importantly, it has effectively minimized the occurrence of serious mistakes or failures in the administration and execution of the work.

Unfortunately, in recent years this system of control of engineering responsibilities has been displaced all too often by political domination of such controls. In other cases the so-called "more efficient package deal" system of contracting has been offered in which the constructor or even the manufacturer of power plant equipment undertakes to provide all of the services, not only of construction and manufacture of the equipment, but also the engineering planning and design, with the engineers appearing in direct partnership or as sub-contractors. It is inevitable that in such cases the independent professional control of major engineering responsibilities (in the best interest of the client and the public) is obliterated and displaced by the motivations of easier profits for the constructor or the manufacturer. In some cases this has led to very faulty engineering planning and construction, or in other cases to scandalous performances in diverting and wasting public funds even though the design and construction may have been of good quality.

III. UNIQUE HISTORICAL FACTORS IN ATOMIC POWER DEVELOPMENT

The unique circumstances under which atomic power has been developed appear to be largely the result of an historical coincidence. In 1939 experimental demonstration had been made of the phenomenon known as nuclear fission. This same year also saw the outbreak of World War II. When it became evident that this newly discovered phenomenon might be applied to the fabrication of a weapon with unprecedented destructive power, the subject of nuclear fission (atomic energy) became a "top secret" high priority program under strict military control. This program was almost totally concerned with the development of a new type of bomb. Destruction was the primary objective; cost was of secondary concern. The terrifying demonstration of the atomic bomb's power in 1945 removed all doubts regarding the outcome of this wartime project.

With the advent of the fearfully destructive power of the atom has come a universal hope that eventually this power would be harnessed for equally impressive purposes in the service of mankind. Unfortunately, however, this hope has been permitted to grow, through excessive publicity and false propaganda, to a point where the practical realities have become obscured. Once a new scientific concept with revolutionary potentialities has been demonstrated to have a certain "technical feasibility," it is still far removed from economic application.

After the end of World War II the high priority program of atomic energy for military use was modified. This led to the passage of the Atomic Energy Act of 1946 (60 Stat. 755), which established atomic energy as a Govern-

ment monopoly. A basic factor in this decision (as acknowledged by the Congress in the Act itself) was the inability to predict how, or when, atomic energy could be used for civilian purposes. Accordingly, research and development of atomic power reactors for the production of electricity grew up as a monopoly venture under the control of the Atomic Energy Commission.

As in the case of the atomic bomb, the atomic power reactor also employs the principle of nuclear fission but, instead of suddenly releasing an enormous body of heat by explosion, the power reactor[1] is designed to maintain a controlled release of a limited amount of heat over a long period of time. This controlled heat is delivered to a heat exchanger where water is converted to steam; the steam, in turn, drives a conventional turbine generator for the production of electricity.

The appropriation of great sums of federal funds provided a major impetus for the atomic power program. Any question regarding soundness of the program was swept aside by a variety of considerations, including: willingness to accept unsupportable claims regarding the great potentialities in the new science; and desire for prestige by being first among the scientists of the various nations with any new developments.

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[1]The special type of reactor to be employed by PRDC is called a "breeder reactor." The energy source will be fuel rods of enriched uranium. As these are consumed by fission at high temperature for the production of steam and the generation of electricity, a transformation occurs within the fuel rods and surrounding "blanket"; this results in a phenomenon called "breeding" in which some of the uranium (U-238) is converted into plutonium (Pu-239). Since this plutonium is not expected to be used in this reactor, it will be sold back to the Atomic Energy Commission for other uses.

The term "breeding" applies only to this transformation of materials. It does not infer some kind of "reproductive process" of creating new energy for prolonging the operation of this reactor. The total energy resource which entered the reactor at the beginning of the cycle is, of course, reduced by the amount of heat energy which is consumed for the generation of electricity.

It was not until 1951 that private groups were permitted to undertake limited studies in the application of atomic energy for the production of electricity. Even then, however, such studies were essentially under the complete control of the Commission, and were subject to all of the then prevailing regulations of secrecy and other restrictions.

Continuation of Governmental Controls

Interest continued to develop in the application of atomic energy for civilian purposes, and this led to the passage of the Atomic Energy Act of 1954 (68 Stat. 919). The Act of 1954 was designed, as were subsequent amendments, to permit private industry to employ the new technology in the construction of a limited number of atomic power plants. Despite the relaxation in the governmental monopoly of atomic energy, however, the Government still retains the following functions:

(a) It is the sole producer of enriched material for fuels to be used in power reactors.

(b) It sets the price of nuclear fuel and is empowered to guarantee prices or waive its charges.

(c) It owns and controls many of the basic research centers concerned with atomic energy and the information released therefrom.

(d) It has the power to pre-empt ownership of all patents which pertain to atomic developments.

(e) It is a leading developer of various types of atomic power reactors.

(f) It subsidizes, or has some form of financial stake in virtually all of the atomic power plants, publicly

or privately owned, now in operation or under construction.

Limitations in Application of Engineering Responsibility

In retrospect it is quite apparent that the origin and growth of atomic power has followed a reverse sequence to that which has taken place in the development of the conventional sources of power—coal, oil, gas and water. In these compulsive circumstances, the engineering profession is confronted with the question of how to apply its traditional disciplines and responsibilities for public safety to the production of electricity under the following new conditions:

(1) The scientific principles of the atomic power reactor are understood by relatively few scientists, and by very few engineers.

(2) Only limited knowledge is available regarding the reactor's heat-producing characteristics in large quantities and over prolonged periods of time.

(3) An atomic power reactor is known to be a highly dangerous device, and its design and application must be developed with extreme care.

(4) No adequate record of operating experiences is available which might serve as a significant guide for the design of large power reactors.

(5) It is known that a major failure of a power reactor could do tremendous damage to life and property.

(6) The insurance companies are unwilling, in fact unable, to assume the full liability for any major

reactor failure, or to protect the owners and operators of the power reactor from damage and death claims following a reactor failure.

(7) The consequences of sabotage or deliberate inducement of a major failure in a power reactor could lead to tremendous damage to life and property; there is no clear prospect of developing a simple design which would protect the public against this contingency.

(8) The ultimate cost of a reactor power plant cannot be satisfactorily predicted and could, conceivably, overrun an estimate two or three times.

(9) It is known that the cost of producing electricity from an atomic power plant is several times greater than the cost of electricity from conventional steam plants. Furthermore, the cost of various items, such as nuclear fuel rods and the disposal of waste, contain government subsidies of unknown magnitude.

(10) From an engineering standpoint there is no economic justification for an atomic power plant.

(11) At best, if investment cost and operating cost were to be disregarded, an atomic power plant may be considered an experimental facility.

(12) The development and control of this new science is in the hands of the Federal Government, and anyone wishing to engage in it may be obliged to work under restrictive regulations and rules of secrecy. This is an unprecedented situation. The conventional and traditional atmosphere of free-

dom of exchange of knowledge among engineers does not prevail.

(13) There is no indication that a system of checks and balances in engineering responsibilities prevails in this new field.

(14) No legal structure within the accepted principles of the "rule of law" and the Constitution of the United States has been established with respect to this new area of science. (See comments on Rule of Law, *infra* pp. 53-54.)

IV. BASIC PROBLEMS IN POWER PLANT LOCATION

Electric energy is produced for the benefit of the consumer. It has the unique characteristic of portability by means of transmission lines, and where it originates is of no direct concern to the consumer. Hence, there is considerable freedom of choice in the location of generating (or power) plants. As a first step, and for comparative purposes, the criteria which generally govern the location of the conventional types of power plants are presented.

Choice of Location of a Thermal Power Plant

A coal-burning steam power plant may be located either at the mouth of a coal mine or adjacent to an industrial load center, the choice depending on whether it is more economical to transmit the electricity or to transport the coal between the mine and the load center. An oil-burning steam plant is usually located near the load center, because of the ease and economy of transporting oil in pipelines.

The detailed choice of location of the power plant and related fuel storage, and the detailed design of the high-

pressure steam boilers and all other components, is dependent upon well established engineering criteria which, in turn, are based on long records of experience in the operation of similar power plants throughout the country. Such engineering decisions must also meet with the approval of the insurance underwriters. This system of control of the safety features in design and location of thermal power plants has evolved from the free interplay of opportunity and responsibility brought about by private or local initiative, tested by experience, generally governed by sound economic considerations in their application, and, as the need arose, subject to regulatory controls by public utility commissions.

Another basic influence in this process of engineering development has been the record of failures and disasters in earlier power plants. It is part of the history of engineering that many of the most important advancements in the art have been developed from the lessons learned through the occurrence of major failures or disasters. Such failures obviously were not expected to occur. However, whenever they have occurred, the resources of the engineering profession have been mobilized to identify their cause and to establish modifications in engineering practice which have helped to prevent their recurrence. This is part of the slow and difficult process by which the art of engineering advances step by step and with due regard for the public's safety.

Choice of Location of a Hydroelectric Power Plant

There is less freedom of choice with respect to the location of a hydroelectric power plant. It must be located

where a river has a site which is favorable to economic development. Such a location may be hundreds of miles distant from the load centers, and the electric energy must be conveyed over long transmission lines to the consuming areas.

Choice of Location of an Atomic Power Plant

The possibility of a serious reactor failure introduces some overriding considerations in any decision involving the location of an atomic power plant. The failure of a reactor, which involves the release of radioactive material to the atmosphere, can inflict terrifying damage on the property and on the population which may be located in the vicinity. The magnitude and extent of such destruction will be discussed later in greater detail.

Furthermore, the operation of an atomic power reactor introduces some new problems with respect to waste disposal. Reactor waste products are highly radioactive and so dangerous that they must be permanently stored in inaccessible places. These problems have been solved only to a limited degree. At present there are no economical solutions available, and, of course, no experience to guide the engineering profession in this new area of responsibility.

Under these circumstances a professional engineer might undertake the design of an experimental atomic power plant of limited size and cost and apply the highest degree of skill and judgment to the design of all its elements. However, there would still remain the overriding problem of locating this new power plant so it could not become an undue hazard to public life or property.

The solution which could be regarded as most acceptable by responsible engineers would be to construct such a power plant at a remote location and within a cavern excavated far back in a solid rock formation; as in the case of many hydroelectric developments, the electrical output would be delivered over long transmission lines to the load center. This concept of design was actually developed by some of the world's most competent engineers and has been adopted as a requirement in some other parts of the world. It was assumed that, in the event of any major failure of the nuclear reactor, the passageway to the cavern would be permanently sealed off and the project could be abandoned, without having exposed life or property in the vicinity to harmful radioactivity.

A Failure in Professional Engineering Responsibilities

In the case before this Court, as will be indicated in greater detail, it is a regrettable fact that the conventional responsibilities of the professional engineer, and his overriding obligations to the public safety, have not been fully respected. Furthermore, the essentials of professional freedom and moral duty to serve the best interests of the public and of the country did not prevail. If professional freedom had prevailed, it is most probable that the project now being contested before this Court would not have been constructed at the present site.

Hence it must be said of this project that the *choice of location* is the result of a denial of professional freedom, and of a terrifying violation of engineering disciplines and ethics. To support such a broad declaration requires an examination of the circumstances which led to the choice

of the present location, and of the evidence which was available at the time regarding the potential hazards to the public.

If a remote location actually was recommended (as representing the best judgment of an independent consulting engineer), there is no evidence that such an opinion was considered acceptable, or that such independent and responsible judgment was invited. Furthermore, there is no evidence that the engineering profession publicly protested this violation of its professional disciplines and its stature before the public. The net result was that those responsible for construction of this project made the deliberate choice of a site in the vicinity of two large cities. The apparent reasons for this choice are without precedent and must be regarded as historically incredible. These are the basic issues which have brought the present case before this Court.

V. CRITERIA FOR SAFETY AND PUBLIC HEALTH

It is noteworthy that in all engineering, the criteria for design, or for the protection of health and safety, have of necessity been established in advance of full understanding of the related scientific principles. Much remains to be learned in all areas of engineering; this applies particularly in the area of public health. In this area the factor of safety has always been large and in favor of the public.

To cite a specific case, the supply of safe drinking water in every locality is an example, on a nationwide scale, of applied disciplines in engineering. The American system of water supply may truly be called a miracle. The con-

tinuity of such a standard of service demands constant vigilance and attention to many details on the part of thousands of engineers and employees in water works. Certainly, no one would advocate a lower standard of safety in water supply for the sole purpose of saving some money. It would be considered preposterous if a public official were to advocate a lower factor of safety and cheaper water supply on the premise that the community would be financially ahead, even if this were to result in an occasional contamination of the water—or outbreak of typhoid—or a "slight" rise in the death rate.

Criteria for Radiation Limits for Human Beings

> "It is only with research for criteria for radiation limits that one finds suggestions that it should be permissible to kill people to attain benefits to society. This has undoubtedly been in the minds of all criteria makers, but rarely has it reached the frank and stark pronouncements of recent years."

Thus testified one of the most competent living authorities in the field of sanitary engineering before the Joint Committee on Atomic Energy in 1960.[1] He continued:

> "Fear has been expressed that the establishment of too rigid criteria for the radiation activity may stifle progress because of excessive costs of attainment. One may view this fear with some cynicism in the light of the whole history of health and safety endeavor. This fear has always been expressed, but the historical realities consistently bely it. Criteria must rest upon upon health protection and not cost.

* * *

[1] **Hearings on Radiation Protection Criteria and Standards: Their Basis and Use**, before Joint Committee on Atomic Energy, 86th Cong., 2d Sess. pp. 29-45.

"No one, of course, should advocate excessive and unnecessary restraints. Those restraints most logically suggested, however, within the framework of current scientific understanding should not be resisted solely because resulting costs may threaten to throttle application. This should be scrutinized with a great deal of care before it is accepted as a base line of decision.

• • •

"The radiation field is today confronted with similar problems and decisions, greatly complicated by the very nature of the biological effects to be considered. The effects of radiation are unclear and not fully predictable with assurance, perhaps for some years. Yet one cannot bide one's time in placing restraints upon the public and private producer. These latter do not have an unblemished record of self-policing. Hence society must look to scientific groups and public officials for providing criteria and guides, at times admittedly uncertain, and others admittedly tentative. As knowledge increases, reappraisals ensue, either for relaxation or for tightening of criteria. These supposedly fumbling steps have much historical validity and precedent in public health practice. . . .

"The day of handbook rule for measuring the hazards of radiation is a long way off. In the meantime one acts upon limited knowledge. In such action the guiding principle must be the maximum protection of the people, not because of sentiment but because society demands it. An agreed acceptance of a number of consequent disabilities is not an appealing basis for the development, say, of nuclear power. Industry will do better than rest upon such an affront to man. I know they will, and have."

VI. REPORT OF ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The problem of appraising the safety aspects of the Lagoona Beach project under "the guiding principles of maximum protection of the people" was assigned to an independent committee of scientists and engineers known as the Advisory Committee on Reactor Safeguards (ACRS). On June 6, 1956, this committee reported to the Atomic Energy Commission that it had reviewed the application of PRDC and had come to the conclusion that it could not approve the application.* Quoting from the report:

> "The proposed PRDC reactor represents a greater step beyond the existing state of the art than any other reactor of comparable power level which has been proposed by an industrial group.
>
> * * *
>
> "From this review the following conclusions were derived:
>
> 1. "Even though there are no facts or calculations available to the committee that clearly indicate that the proposed reactor is not safe for this site, the committee believes there is insufficient information available at this time to give assurance that the PRDC reactor can be operated at this site without public hazard.
>
> 2. "It appears doubtful that sufficient experimental information will be available in time to give assurance of safe operation of this reactor unless the present fast reactor program of the

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* Joint Committee on Atomic Energy. "A Study of AEC Procedures and Organization in the Licensing of Reactor Facilities." 85th Cong., 1st Sess. (Joint Committee Print 1957). p. 133.

AEC is amplified and accelerated as detailed below.

3. "It is impossible to say whether or not an accelerated program would give sufficient information to permit safe operation of this reactor at the Lagoona Beach site on the time schedule presently proposed.

* * *

"The Committee considers it important that bold steps be taken to advance the development of the fast breeder reactor concept and commends the willingness of the Power Reactor Development Company to risk its capital and prestige in advancing the development of this reactor concept. But the Committee does not feel that the steps to be taken should be so bold as to risk the health and safety of the public. It is important for the AEC to provide sufficient development facilities and experimental information that the safety aspects of the PRDC reactor can be reliably appraised in advance of operation of the reactor itself."

Unfortunately, this report was withheld from pubication and the conditional construction permit was authorized by the Commission on August 4, 1956. The report finally was released on October 9, 1956.

Questions Raised by Joint Committee on Atomic Energy

A major difference of opinion regarding this report developed between the Chairman of the Congressional Joint Committee on Atomic Energy and the Chairman of the Atomic Energy Commission.

On August 4, 1956, the Chairman of the Joint Committee issued a statement containing the following:[10]

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[10] Joint Committee on Atomic Energy, Supra note 9, pp. 125-126.

"AEC has informed the Joint Committee on Atomic Energy that it has issued a construction permit to PRDC of Detroit to construct a nuclear power plant near Monroe, Michigan. This is known as the Detroit Edison reactor.

"The issuance of this construction permit, in my opinion, sets a dangerous pattern in the early stages of AEC regulative and quasi-judicial activity for the following reasons:

"1. The AEC has issued this permit as a result of 'star chamber' proceedings in which the report of its Advisory Committee on Reactor Safeguards, which raised grave doubts as to the safety of the proposed reactor, has never been made public by AEC. It is my understanding that this important report, filed on June 6, 1956, which was prepared by a distinguished committee of experts, has not been retracted or modified by them.

* * *

"4. From a practical standpoint, AEC might feel obligated to go on through with a bad deal with respect to public safety because they will have permitted the expenditure of huge sums under the construction permit. It is my belief that decisions on safety should be made without any examination of dollars involved but only from the standpoint of human lives."

VII. PROBLEMS OF INSURABILITY

Traditionally the power industry has developed under laws which, in essence, hold the individual power companies responsible for any damages which their activities might inflict on the public. This concept of liability has proven to be a strong influence upon the industry in developing its

high record of safety. As a result, new scientific and technological developments have been adopted only after undergoing severe tests, and after adequate proof that the adoption of any new equipment would be consistent with the prevailing standards of safety.

A vital factor in this process has been the private insurance industry. For example, as boilers for steam power plants have increased in size and output, it has taken many decades to develop the responsible criteria of design under the constantly increasing temperatures and steam pressures. In such details as the metallurgy of the steel, welding and fabricating procedures, installation, operating controls, and safety devices, the great traditions of responsibility in engineering and in manufacturing have served as a foundation for taking each progressively higher step. In all of this development the insurance industry has participated with clear understanding of its responsibilities, and has insisted on the application of sound engineering disciplines before it would assume the liability for public damage due to explosions or other accidents.

In the atomic power field, on the other hand, the insurance companies were confronted with a new peril in which experience is almost totally lacking. At the same time they were confronted with demands for coverage of unprecedented magnitude. After considerable study the private insurance industry was obliged to announce that it would be unable to offer satisfactory public liability insurance on atomic power installations. The position of the private insurance industry was summarized in a comprehensive report from which the following is quoted:"

"Hearings on **Governmental Indemnity** before Joint Committee on Atomic Energy, 84th Cong., 2d Sess. pp. 248-250.

"The hazard is new. It differs from anything which our industry has previously been called upon to insure. Its potential is still unknown and must therefore be calculated currently in terms of a body of knowledge which is expanding from day to day.

"Very few insurance companies have had any opportunity to develop first-hand knowledge of the problems involved because of the present limited scope of operation. By the same token, very few insurance companies have developed trained technical personnel to assist their underwriting personnel in insurance evaluation of the hazards involved.

"The catastrophe hazard is apparently many times as great as anything previously known in industry and therefore poses a major challenge to insurance companies. . . . We have heard estimates of catastrophe potential under the worst possible circumstances running not merely into millions or tens of millions but into hundreds of millions and billions of dollars. It is a reasonable question of public policy as to whether a hazard of this magnitude should be permitted, if it actually exists. Obviously there is no principle of insurance that can be applied to a single location where the potential loss approaches such astronomical proportions. Even if insurance could be found, there is a serious question whether the amount of damage to persons and property would be worth the possible benefits accruing from atomic development."

Catastrophe Hazards.

In addition to the damage to the power plant and operating personnel from a conceivable accident in an atomic reactor, the far greater hazard lies in the radiation exposure and contamination which could occur if the fission products should be released to the surrounding area. It is

conceivable that accidental atomic or chemical reactions within the reactor or auxiliary systems could destroy equipment, break the containment structures, and release the accumulated fission products to the atmosphere in a highly divided state. Once airborne, these toxic products could be widely dispersed, threatening the health and safety of people over wide areas. The danger may be emphasized by noting that some radioactive materials are more than a million times as toxic as chlorine, the most potent common industrial poison.

Naturally, the Atomic Energy Commission, as well as the manufacturers and public utilities engaged in atomic power development, have been deeply concerned over the type and amount of damage to people and property which could occur in the event of a major catastrophe, and with the problems of settling the ensuing damage claims.

In March 1957 the Atomic Energy Commission published a report which is generally known as the Brookhaven Report: "Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants."[12] This report contains the studies of an "assumed condition of accidental failure" of an atomic reactor with an electrical power capacity of 100,000 to 200,000 kw and located on a river about 30 miles from a major city. Various assumptions and conditions of the surrounding region were defined to provide some basis for computation. It must, of course, be kept in mind that some of the problems involved are extremely difficult to analyze. However, the figures were intended to serve as an "order of magnitude" indica-

[12] "Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants." ("Brookhaven Report"). R. 874-917.

tion of the possible consequences of a major reactor failure. Such a failure could result in contamination of large areas from deposited fission products. Inhabitants of portions of the areas affected would have to be evacuated to avoid serious exposure. Standing crops would be lost. Agricultural use would be curtailed. Access to various areas would be restricted for considerable periods of time.

The results of these studies indicated that, depending upon the weather conditions and temperature of the released fission products for the assumed accident, the property damage alone could range between $2,300 million and $4,000 million and possibly higher. Damage to health and life could be in the order of 43,000 injuries and 3,400 fatalities, without taking into account the probability of harmful long-term effects on several hundred-thousand people. The financial liability for human casualties was not evaluated and obviously is beyond comprehension.

It might well be wondered, under these circumstances, how any agency engaged in the generation of electricty could afford to undertake the construction of an atomic power plant when faced with the possibility of becoming liable for such vast potential damages.

Government Acceptance of Liability

Eventually the private insurance industry, after pooling all its resources, committed itself to underwriting liability coverage on a single atomic power installation in the amount of $60 million. However, this represents only a small fraction of the potential damage to life and property from a major failure of an atomic reactor.

To resolve this impasse, a proposal was advanced which must be regarded as a great historical tragedy in the affairs of our government. The Atomic Energy Commission chose to recommend to the Congress—and the Congress saw fit to enact—legislation by which the liability, except for the comparatively small coverage provided by the private insurance industry, was transferred to the taxpayers of the nation. The 85th Congress adopted Public Law 85-256, known as the "Price-Anderson Act," which added Section 170 to the Atomic Energy Act of 1954. This Act was approved on September 2, 1957. (42 U. S. C. 2210)

Under this Act the United States Government has assumed a liability which is stated as a maximum of $500 million for each accident. However, in view of the commitment in principle, it is difficult to visualize how the Government could escape a much greater liability in the event of a larger disaster. The possibility of such a disaster occurring, obviously, has been acknowledged by the passage of this amendment. Representatives from the power and manufacturing industries had stated that without such assumption of liability by the government they would not be able to continue their participation in the atomic power program.

The enactment of these indemnity provisions into law, however, has not eliminated the hazard. It has served only to relieve the individual power companies and the manufacturers of the traditional system of financial liability by transferring such liability to the Federal Government. In this manner the way was paved for building so-called "low-cost atomic power plants" near the load centers. Following enactment of the Price-Anderson Act, a number of publicly and privately owned atomic power plants have been under-

taken with governmental approval near populous areas, thus subjecting the people, without their consent, to unnecessary and unprecedented hazards. The ultimate liability in the event of a disaster has been transferred, according to law, to the nation's taxpayers.

The net result of this action has been to circumvent and disrupt the traditional system of disciplines and responsibility of the engineering profession. As has been previously stated, the public has great confidence in the engineering profession to protect the public health and safety, and professional engineers are expected to assume their responsibilities and serve under the highest standards of ethics and intellectual honesty. However, these standards cannot prevail under a system of government indemnity which displaces such responsibilities.

Probability of An Atomic Disaster

It has been alleged that the location of an atomic power plant near a populated area is permissible on the grounds that the many safety precautions taken to avoid an accident render the possibilities of an atomic disaster "exceedingly improbable." However, as noted previously, such assurances in no way alter the fact that virtually every major accident or disaster which has occurred in past history has been "exceedingly improbable."

History has clearly demonstrated that man, with his imperfections, has never been able to foresee all future technical events. Despite his best efforts, failures have occurred; at the same time, he has used these failures to increase his knowledge and widen his range of confidence. In the face of this long-established historical fact, the atomic

energy program is currently being promoted on the assumption that a major accident will not occur. However, despite the excellent technical efforts which have been applied to date, such an assumption, particularly in view of the completely new technology involved, must be regarded as utterly unrealistic.

Failures in the Field of Atomic Energy

Although the atomic energy industry is very young and has relatively few installations, it has achieved an impressive record of safety in its brief history. In fact, it seems doubtful that any other industry can show greater concern for safety in terms of time and effort, or money expenditures. However, reassuring as this fact may be, it is also significant that despite this safety effort, failures are still occurring. Such failures range from relatively minor ones to the more serious. In most cases the reactors which have failed have been relatively small. Some of the failures in the operation of atomic reactors have resulted in deaths, or have exposed considerable numbers of persons to radiation.

A failure occurred in December 1950 at the National Research Experiment (NRX), Chalk River, Canada, which resulted in a nuclear runaway and explosion. This accident is not widely known because the security regulations at the time of the incident were very strict; but it resulted in the death of one man and the serious radioactive contamination of five others.[11]

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[11] Hayes, D. F. "AEC Experience in Radiation Accidents." In **A Compendium of Information for Use in Controlling Radiation Emergencies."** U. S. Atomic Energy Commission. Report TID-8206 (Rev.). September 1960. pp. 2-3.

At Windscale, England, in 1957 a fire in an atomic reactor resulted in the widespread release of radioactive material over the surrounding countryside. It fell on the pasture lands of farms in a 200-square-mile area. The cows, while grazing, absorbed the fallout of iodine-131; it reappeared in the milk. Fortunately this was discovered almost immediately by scientific monitoring, and resulted in a ban on the use of all milk produced in this area. It was considered advisable to dump all the milk for a period of two months to prevent its consumption by young children who might otherwise have accumulated significant quantities of radioactive iodine in their thyroid glands. The report of the board of investigation stated that the cause of the accident was due partly to inadequacies in the instrumentation provided for the control of operations, and partly to faulty judgment by the operating staff, these failures in judgment being themselves attributable to weaknesses of organization."

Although both of these failures, among a number of others, have occurred outside the United States, published accounts have recorded 39 failures in reactors of various types in this country.

On January 3, 1961, about 9 p. m. a failure occurred near Arco, Idaho, in an AEC prototype power reactor rated at 200 kw. This resulted in the death of three persons who were working on the reactor at the time of the accident. Prior to this failure it was known that a variety of troubles had developed, some having their origin in the design and others in the operation of the reactor. Because of the high

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"Accident at Windscale No. 1 Pile on 10th October, 1957." Presented to Parliament by the Prime Minister by Command of Her Majesty. November 1957. Cmnd. 302. London. HMSO

radiation levels inside the building, it has not been possible to enter and determine the cause of the failure.

The AEC report of January 27, 1961 states:

> "Because of the high radiation levels, it was not possible to remove the second crewman until January 5, and the third crewman until January 9."
>
> * * *
>
> "At this time it is not possible to identify completely or with certainty the causes of the incident. The most likely immediate cause of the explosion appears to have been a nuclear excursion resulting from motion of the central control rod. As yet there is no evidence to support any of several other conceivable initiating mechanisms."[1]

These and other failures provide impressive evidence that no matter how great an effort may be made to prevent them, accidents will occur. This is particularly true in the development of a technology as new as atomic energy—much still remains to be learned.

Steel Containment Vessel

During the early 1950's there was considerable discussion on how to design an unprecedented type of power plant containing an atomic reactor. As a basic principle it was generally agreed that every effort should be made to minimize the hazard to the public as much as possible.

It had been determined that any release of fissionable material to the atmosphere could have a terrifying and dis-

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[1] "Interim Report on the SL-1 Incident." Report of the General Manager's Board of Investigation. U. S. Atomic Energy Commission. January 27, 1961. pp 2, 11.

astrous result on public life and property in the vicinity. The possibility of such an occurrence, no matter how remote it might be, had to be admitted. These considerations eventually led to a proposal to construct a steel plate "containment shell" or dome completely surrounding the reactor unit. This dome presumably would confine whatever cloud of fissionable material might otherwise be released to the atmosphere. The dome at the PRDC (Enrico Fermi) atomic power plant at Lagoona Beach consists of a steel shell 72 ft. in diameter, 120 ft. high, and with varying thicknesses of steel plate from 0.52 to 1.25 inches.

Such a structure has become a highly controversial design concept and there is a considerable body of professional engineering judgment that it is of extremely limited value in safeguarding the public.

It could be claimed that the design of this dome has had the benefit of a careful review by the United States Naval Ordnance Laboratory in White Oak, Maryland. However, an examination of this report indicates that it does not claim to be a comprehensive treatise on the containment problem for this reactor power plant, and that many of the containment problems that are peculiar to this reactor have never been solved either experimentally or theoretically.

The limitations and reservations noted in this report reveal that the authors and the officers of the U. S. Naval Laboratory recognize the tremendous responsibilities involved in the over-all project. They have stressed the fact that their participation in a limited study area may not be regarded inferentially as approval of many other important areas which have not been studied. This sense of respon-

sibility is in keeping with high professional engineering standards and is worthy of commendation. (It is regrettable that this report has not been given the degree of recognition commensurate with its importance.)

The following quotations from the Abstract of this report indicate the great care with which the U. S. Naval Laboratory approached this problem:

> "A study has been made on the ability of the Enrico Fermi fast breeder reactor plant to contain a nuclear excursion equivalent to the violence produced by 1,000 pounds of TNT. The results of the study indicate that the reactor plant can contain shock waves developed in the air and in the sodium and also fragments from the cylindrical covering materials surrounding the reactor core. The rotating shield plug, however, is a serious hazard when projected by the gun action of the internal blast pressure in the reactor compartment. This problem is analyzed and a recommendation has been made to lessen the danger.
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> * * *
>
> "This report is not claimed to be a comprehensive treatise on the containment problem for this reactor plant. To do so would go far beyond the intended scope of this study. *Many of the containment problems that are peculiar to this reactor have never been solved experimentally or theoretically.* Conclusions that have been made are based on concepts taken from applicable areas of explosions research.
>
> "It is emphasized that this entire report is *based on information furnished* by the Atomic Energy Commission that the most probable upper limit of energy release from a power excursion of this reactor is estimated to be 4.54 times 10^8 calories. *Within this limita-*

tion and others noted here and elsewhere in the text, this report is presented for information purposes."[10] (Emphasis added)

The limited value of the containment shell or dome, from the standpoint of public safety, is particularly understood by those who have some appreciation of the consequences of sabotage or other possibilities of planned destruction. (Some descriptions of its protective value are reminiscent of the Middle Ages and indicative of the controversial nature of this design concept.)

"Compelling Reasons" Criterion is Sound and Desirable

One of the questions before this Court is whether the Commission must establish "compelling reasons" before it can approve the location of a reactor near a heavily populated area. However, the petitioners claim that this would "seriously impede and, in significant areas, might even block the programs and policies that the Atomic Energy Commission had carefully developed" with regard to atomic power development in this country.[11]

In view of the dangers in an atomic power plant, as acknowledged by the passage of the Indemnity Act, it is difficult to visualize any "compelling reasons" which could be cited in support of locating a reactor power plant near a populated area. It may be argued that to require the location of an atomic plant in a remote area would result in greater cost of such power to the consumer, and thus

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[10] **"Containment Study of the Enrico Fermi Fast Breeder Reactor Plant."** U. S. Naval Ordnance Laboratory, White Oak, Maryland. NAVORD Report 5747. 7 October 1957. pp. i-ii.

[11] Petition for a Writ of Certiorari filed by the Government and AEC, No. 454, This Term, p. 11.

postpone the day when atomic power would be economically competitive with thermal or hydro power. However, such an argument lacks merit for three important reasons: (1) It tends to disregard the question of public health and safety; (2) references to atomic power becoming "economically competitive" with electricity produced by conventional means are meaningless because no acceptable basis for comparison of costs between the two methods is available;[1] and (3) it ignores the fact that hydroelectric plants, of necessity, frequently are located at great distances from the service areas.

While it may be argued that the possibilities of an atomic disaster are "believed" to be extremely remote, any effort to claim this as sufficient justification for locating an atomic power plant in the vicinity of a populated region must be regarded as a gross violation of professional engineering responsibilities. To ignore available alternatives and knowingly to expose a large population to a hazard of unprecedented magnitude, however remote its occurrence may seem, must be regarded as a gross violation of moral and ethical standards, not only in engineering but also in industry and in government. For a government or its agency to violate such standards and, in addition, to offer incentives which contribute to the violation of such standards, must be regarded as a revolutionary departure from the fundamental principles established by the Constitution of the United States.

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[1] All of the cost components of conventional power plants are determined through the competitive operations of a free market. On the other hand, many of the comparable costs of atomic power plants are established administratively by governmental authority.

VIII. A SILENT REVOLUTION IN OUR FORM OF GOVERNMENT

In this technological age the influence of the scientist and of the engineer (the experts) has assumed tremendous importance in governmental affairs. It may not be remiss at this point to call attention to the relatively simple device by which the highly complex field of science and technology, when dominated by governmental authority, can be applied over a period of years to the introduction of revolutionary changes in our form of government. This is particularly true where we find displacement of independent professional responsibilities, or where a commission is so constituted that it regulates its own acts. It is out of such procedures that a new system of "administrative law" is born. Over the years this tends to grow up to form a new legal structure in place of our conventional system of the "rule of law"—and generally beyond the reach of Constitutional controls and our judicial system. We have been warned that eventually such a legal structure can deteriorate into "administrative lawlessness."

The trend towards administrative procedures and law was clearly outlined by the late Lord Chief Justice of England in 1929:"

> "Two main obstacles hamper the beneficent work of the expert. One is the Sovereignty of Parliament, and the other is the Rule of Law.
>
> "A kind of fetish-worship, prevalent among an ignorant public, prevents the destruction of these ob-

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"Hewart of Bury, Rt. Hon. Lord. Lord Chief Justice of England (dec.). **The New Despotism.** (Ernest Benn, Ltd., London), pp. 20, 23.

stacles. The expert, therefore, must make use of the first in order to frustrate the second.

"To this end let him, under Parliamentary forms, clothe himself with despotic power, and then, because the forms are Parliamentary, defy the Law Courts.

"This course will prove tolerably simple if he can: (a) get legislation passed in skeleton form; (b) fill up the gaps with his own rules, orders and regulations; (c) make it difficult or impossible for Parliament to check the said rules, orders and regulations; (d) secure for them the force of statute; (e) make his own decisions final; (f) arrange that the fact of his decision shall be conclusive proof of its legality; (g) take power to modify the provisions of statutes; and (h) prevent and avoid any sort of appeal to a Court of Law."

In this same essay the following warning has been sounded:

"It is, or at any rate it was until quite recently, a commonplace to say that the 'Rule of Law' is one of the two leading features which distinguish our Constitution. So it has been ever since the eleventh century, and, if this leading feature or essential characteristic is to be diminished or destroyed, it seems at least desirable that the work of diminution or demolition should be openly and frankly performed, with the British public standing by, fully instructed and deliberately consenting. Nothing could well be more unfortunate than that a change of so fundamental a character should be brought about piecemeal, by subterranean methods, which might escape general observation until the mischief had been carried to completion."

IX. ISSUES RELEVANT TO THE QUESTIONS BEFORE THE COURT

1. Technology has clearly emerged as a mighty shaper of human destiny. With the development of science and engineering to this dominant role, scientists and engineers have the responsibility of opposing the harmful exploitation of these powerful influences.

2. The two areas of responsibility, as between science and engineering, must be clearly understood. *Scientific truth* is naked truth. A scientific principle is a naked principle. *Engineering truth* is fully clothed in ethics and morality. It is founded on the proposition of individual responsibility. In the application of scientific principles the engineer is expected to serve the public interest with due regard for the preservation of the Rule of Law and our Constitutional system of government. In developing new plans for the future, the engineer interprets the experiences of the past and adds the vital ingredients of imagination, sound judgment and integrity.

3. The atomic age has brought out a major biological factor in our world. The development of atomic power installations has brought with it the problem of radioactive hazards which is becoming an ever increasing danger to human life. In the application of this new science, safety of human beings is the most important consideration. Nuclear radiation not only endangers their immediate health, but also may harm or destroy their offspring.

4. The operation of a large atomic power plant involves many people; a failure in its control can occur at human hands by careless handling, lack of experience, by

accident, or by criminal action such as theft or sabotage. Failure can also occur through errors in design of the complex and highly technical apparatus. A general release of radioactive materials, as has already happened, allows them to be spread over the countryside and into the rivers, ultimately reaching man through water and food of all types. "With all the inherent safeguards that can be put into a reactor, there is still no foolproof system. Any system can be defeated by a great enough fool. The real danger occurs when a false sense of security c' uses a relaxation of caution."[20]

5. The individual scientists and engineers, as well as the leaders in their professional societies have a traditional responsibility of presenting truthful information on both successes and failures in their work and to protest against efforts to misuse their services. Unfortunately the field of atomic power is suffering from lack of interest and concern on the part of most engineers, and from lack of responsible leadership. Furthermore, it is clouded by a variety of professional papers and publications, many of which are misleading or purely propaganda. The lessons of experience in this field are in their embryonic stage and, as the National Academy of Sciences has stated: "Present experiences give us only a shadow of a presentiment of what is yet to come."

6. The atomic power plants which for the most part are being undertaken by private industry at a loss are intended to develop technical knowledge and experience. "There was always a sort of threat, however, that if pri-

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[20] McCullough, C. Rogers, Chairman of Advisory Committee on Reactor Safeguards, AEC. "The Safety of Nuclear Reactors," in **1955 Geneva Conference Proceedings** (New York, United Nations, 1956) Vol. 13, p. 79.

vate industry did not do so the government would build the plants itself. What, if any, influence this had upon private industry's decision it is not possible to say."[21]

7. The threat of government competition to gain political objectives has been the subject of much discussion, as for example:

> "There can be little doubt, when government owns and operates a significant proportion of the capacity to produce electric power, that it gives to the government a greater ability to dominate and manage other economic activities. Those who favor centralized economic planning (or socialism in the sense of government ownership and operation of the basic industries), are naturally concerned about the role of government in the atomic industry. In the United States, the socialist voice seems to make itself heard by means of the public power advocates in our national legislature, who desire to retain nuclear produced electric power as a national monopoly. If this is possible, not only for electric power but for other aspects of atomic energy as well, the degree of central direction of all economic affairs would be increased and facilitated. . . ."[22]

8. The tendency of technicians to favor centralized planning was examined a few years ago, with great clarity and understanding.[23]

9. It is an ominous spectacle to see governmental authority taking charge of scientific discovery, and undertaking public developments without the benefit of an inde-

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[21] "Atomic Energy in a Free Society." Paper presented to Mont Pelerin Society, September 7-12, 1959. In **"Il Politico,"** University of Pavia (Italy), 1960, Vol. XXV, No. 2, p. 296.

[22] "Atomic Energy in a Free Society," supra, note 21.

[23] **Hayek, F. A. "The Counter-Revolution of Science."** Free Press, Glencoe, Illinois, 1952. See esp. Chapter 10, "Engineers and Planners."

pendent and responsible engineering profession to provide the moderating controls of ethics, morality and justice. This could eventually lead to the destruction of our form of government.

10. History has taught us that when political leaders and administrators in authoritative positions find themselves captivated by the premature application of scientific principles, and choose to take overriding control of them for the purpose of gaining high influence or domination over people and nations, without regard to the hazards or harmful consequences, they are practicing a system of usurpation and immorality in government, and are betraying a public trust.

11. The fundamental issue before this Court is not the simple question whether a specific atomic power plant should or should not have been constructed at a particular site. The basic issues are:

(a) Shall the Government of the United States, by legislation and administrative decision, engage in and foster the application of scientific principles under policies which violate the elementary codes of ethics, morality and justice which have been established by our founding fathers?

(b) Shall the Government of the United States, by the threat of direct competition with its citizens and under its own special rules, place in a defensive position those who are engaged in upholding our system of free and private enterprise under competent State regulatory controls?

(c) Shall the Government of the United States, without the full knowledge and understanding of all its citizens, provide special inducements and incentives for corporations and individuals to engage in the unsound application of scientific principles which contain the hazards of destruction of great numbers of human lives?

(d) What are the responsibilities of scientists and engineers who encourage or condone the enactment of laws for the building of atomic power plants where they will stand as constant threats of disaster to a large number of people at some unexpected time?

12. Whatever may be argued as having been the intent of Congress in the enactment of certain legislation, it must be assumed that Congress expected the highest standards of professional engineering to be maintained for the health and safety of the public. Furthermore, it is evident that any legislation which creates a conflict with the essentials of professional freedom, or which invites a relaxation of professional standards, can be rectified.

13. It is high time we face up to the hypocrisy of our assumptions, and that we express an angry and solemn warning against varieties of intellectual corruption. We must learn to say "No" to both client and cash when the proposition turns out to be something less than the best. The abandonment of principle for expediency is an advanced symptom of the decay of popular institutions, and the plain fact is that the sickness of an acquisitive society has become so acute we must either redeem it or perish.

We must take a moral and principled stand against sacrificing the future of our children and of our children's children and against depriving them of the freedom which is their birthright.

14. Science can provide the answer to many questions but beyond science is God who made both man and science. Man is only beginning to discover science but he is now learning that he can survive on this earth only if he applies science for the benefit of mankind according to the Will of the Creator of all things.

CONCLUSIONS

(1) This Court should find the Atomic Energy Act of 1954 precludes the Atomic Energy Commission from approving a site for an atomic power reactor near a populated area.

(2) The Commission, in granting a permit for the construction of an atomic power reactor, should be required to make adquate findings with respect to the safety of its operation.

(3) The general problems of public policy in the field of atomic power call for re-examination.

(4) Renewed emphasis is needed that our Constitutional form of Government must be respected and defended in the development of modern science.

GENERAL ACKNOWLEDGMENT

In addition to the specific references which have been cited in support of this brief, a comprehensive search has been made in a wide range of publications to gather basic facts in philosophy, engineering and human welfare. The synthesizing of this heritage of the past with the issues of today has, in essence, been a process of engineering design, similar to that employed in designing a bridge. Therefore, a general acknowledgment must be included to all who in the past have sought to show the way toward wisdom and understanding.

Respectfully submitted,

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SUPREME COURT OF THE UNITED STATES

Nos. 315 AND 454.—OCTOBER TERM, 1960.

Power Reactor Development Co., Petitioner, 315 *v.* International Union of Electrical, Radio and Machine Workers, AFL–CIO, et al. United States, et al., Petitioner, 454 *v.* International Union of Electrical, Radio and Machine Workers, AFL–CIO, et al.	On Writs of Certiorari to the United States Court of Appeals for the District of Columbia Circuit.

[June 12, 1961.]

MR. JUSTICE BRENNAN delivered the opinion of the Court.

This case is the first contested licensing proceeding to be decided by the Atomic Energy Commission under the Atomic Energy Act of 1954, 68 Stat. 919, 42 U. S. C. § 2011 *et seq.* It presents the question whether the Commission erred in continuing in effect a provisional construction permit which authorizes the petitioner Power Reactor Development Company to construct, but not to operate, a fast-neutron breeder reactor for the generation of electric power. The Court of Appeals for the District of Columbia Circuit set that order aside. 280 F. 2d 645 (1960). We granted certiorari, 364 U. S. 889 (1960), on petitions of the United States and of Power Reactor Development Company (hereafter PRDC), to decide an important question of the scope of the Commission's power under the Atomic Energy Act of 1954.

Stated more precisely, the question before us is whether the Commission, in issuing a permit for the construction of a facility which will utilize nuclear materials, such as the power reactor presently involved, must make the same definitive finding of safety of operation as it admittedly will have to make before it licenses actual operation of the facility. The Court of Appeals said: "It is undisputed that the Commission must make such a finding when it authorizes operation. The question is whether it must make such a finding when it authorizes construction. In our opinion it must." 280 F. 2d, at 648. Petitioners agree that some finding directed to safety of operation must be made at the construction-permit stage of the proceeding, but argue that the Court of Appeals erred in holding that the Commission must have the same degree of certitude at this preliminary point as when it licenses operation. In order to understand how the controversy arises and what is involved in its resolution, it will be necessary to state the proceedings in the case at some length, and then describe in detail the governing statute and administrative regulations. For the decision of this case ultimately turns on a comparison of what the Commission found with what the statute and regulations require.

The case began on January 7, 1956, when PRDC filed with the Commission (hereafter sometimes referred to as the AEC) an application to construct and operate a developmental power reactor of a relatively new type. This device has two characteristics which distinguish it from other nuclear reactors. First, the neutrons which fly about inside the reactor (to use crude but graphic layman's terminology) and split atoms of fissionable Uranium–235—thus releasing new neutrons and energy in the form of heat—are "fast" neutrons. That is, they travel at a velocity of about 10,000 miles per second, much faster than neutrons in ordinary reactors. Second, this

reactor is a "breeder": it has the property of being able to produce about 1.2 times as much fissionable material as it consumes. This result comes about through a sort of modern alchemy; when the neutrons fly outside the inner core of the reactor, which is composed of fissionable U–235, they enter a blanket of nonfissionable U–238. Atoms in this blanket are changed, when struck by a neutron, into Plutonium, itself a fissionable fuel which can be removed from the reactor and be put to possible use in other installations. Thus, the reactor "breeds" Plutonium faster than it uses up U–235. It not only generates energy to produce electric power, it also creates new reactor fuel. This "breeder" effect is attainable because of the use of fast neutrons. Two boron control rods inserted into the reactor are a means designed to reduce its power level at any time. And in addition to these rods, eight more boron rods are suspended by an electromagnet over the reactor; in case the reactivity rises to a dangerously high level, these safety rods are intended to drop into the reactor automatically and shut it down immediately. The whole machine is housed in a series of thick concrete, graphite, and steel layers, all underground. Over this entire complex is placed a football-shaped building, enclosed in a two-inch steel shield capable of containing an explosion equal in force to 1,000 pounds of TNT, which is greater than any explosion which any of the experts who testified in this case believes is at all likely to result from an accident in the operation of the reactor. The application, after describing the reactor in much greater detail than this rudimentary summary, went on to provide that the reactor would be located at Lagoona Beach, Mich., on the shores of Lake Erie, about 35 miles from the center of Detroit, Mich., and about 30 miles from the center of Toledo, Ohio.

The Commission took the case under advisement and, on August 4, 1956, despite a report of its Advisory Com-

mittee on Reactor Safeguards which was at best noncommittal about the probable safety of the proposed reactor in operation, issued a provisional construction permit without having held public hearings, as the law at that time permitted it to do. This permit was subject to the following condition:

> "The conversion of this permit to a license is subject to submittal by PRDC to the Commission (by amendment of the application) of the complete, final Hazards Summary Report (portions of which may be submitted and evaluated from time to time). The final Hazards Summary Report must show that the final design provides reasonable assurance . . . that the health and safety of the public will not be endangered by operation of the reactor . . . ."

On August 31, 1956, in accordance with the Commission's then existing rules of practice, the respondents in this Court, International Union of Electrical, Radio, and Machine Workers, United Automobile, Aircraft, and Agricultural Implement Workers of America, and United Papermakers and Paperworkers, petitioned the Commission for permission to intervene and oppose continuation in effect of PRDC's provisional construction permit. The AEC granted permission to intervene on October 8, 1956, and set the case down for a hearing before one of its hearing examiners. Extensive hearings were held between January 8, 1957, and August 7, 1957, and on November 22, 1957, in accordance with the AEC's order setting the case for hearing before him, the examiner, instead of issuing an initial decision and opinion of his own, transferred and certified the record of the hearings to the full Commission for its consideration. Oral argument was had before the Commission on May 29, 1958. On December 10, 1958, the Commission rendered its "Opinion and Initial Decision" continuing PRDC's permit in effect, subject to the same condition recited above.

To its opinion were appended extensive findings of fact, including Finding 22, which is of central importance to the decision of this case. That findings read as follows:

> "22. The Commission finds reasonable assurance in the record that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and will be able to be operated at the location proposed without undue risk to the health and safety of the public."

Commissioners Vance and Floberg joined in the opinion. Commissioner Graham filed a short concurring opinion agreeing with the Commission's basic safety findings, just quoted, but doing so in much shorter compass than the majority. Commissioners Libby and McCone (the chairman) took no part in the decision. The result of this initial opinion was an order continuing PRDC's provisional construction permit in effect, but containing the same condition which the original permit, issued on August 4, 1956, had contained.

The intervening unions, as was their right, filed detailed exceptions to this initial decision. The Commission fully reconsidered all the contentions and reviewed the evidence presented at the lengthy hearings, with particular attention to the testimony of the scientific experts, several of them members of the Advisory Committee on Reactor Safeguards, who had testified. On May 29, 1959, the Commission issued its "Opinion and Final Decision," dealing with all questions presented in even greater detail and reaffirming its initial decision. The Commission emphasized that "public safety is the first, last, and a permanent consideration in any decision on the issuance of a construction permit or a license to operate a nuclear facility." Even after operation of the reactor is licensed—if it ever is—the Commission, it said, will retain jurisdiction over PRDC's activities to ensure that the

highest safety standards are maintained. The opinion went on to examine the suitability of the proposed site, noted that it was near a great population center, and nevertheless concluded that at the present stage there was reasonable assurance that the general type of reactor proposed by PRDC would be safe enough at that location. The Commission pointed out, however, that its action in allowing PRDC to proceed with construction was by its nature tentative and preliminary, and that it was by no means committed to the issuance of an operating license. "PRDC has been on notice since before the first shovel of dirt was turned," it said, "that its construction permit is provisional upon further determination of many technological facts, including the complete safety of the reactor." A more severe safety test would have to be passed when the reactor was completed, the opinion said, since "the degree of 'reasonable assurance' . . . that satisfies us . . . for purposes of the *provisional* construction permit would not be the same as we would require in considering the issuance of the *operating* license." The Commission then made new findings of fact, including the following counterpart of its initial Finding 22:

> "22. The Commission finds reasonable assurance in the record, for the purposes of this provisional construction permit, that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and will be able to be operated at the location proposed without undue risk to the health and safety of the public."

All three of the Commissioners who took part in the case joined in this final decision, and the Commission entered its final order continuing in effect the PRDC provisional construction permit, but again subject to the condition that a more extensive safety investigation, and a definitive safety finding, would have to be made before operation was permitted.

The intervening unions, respondents in this Court, then petitioned the Court of Appeals for the District of Columbia Circuit to review and set aside this order of the Commission. Only the final order continuing the permit in effect was drawn in question. No complaint was made of the original *ex parte* grant of the permit in 1956. PRDC intervened in the Court of Appeals in support of the AEC. On June 10, 1960, by a divided vote, a three-judge panel of the Court of Appeals set aside the AEC's order and remanded the case to the Commission. A petition for rehearing *en banc* was denied, two judges dissenting, and we brought the case here.

We turn now to an examination of the statutes and regulations pursuant to which the Commission purported to continue in effect PRDC's construction permit. The basic provision is § 104b of the Atomic Energy Act of 1954, 42 U. S. C. § 2134 (b), which authorizes the AEC to "issue licenses to persons applying therefor for utilization and production facilities involved in the conduct of research and development activities . . . . In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this chapter to promote the common defense and security and to protect the health and safety of the public . . . ." Two things about this section should be emphasized. First, there is no doubt that the term "licenses" as used therein includes the provisional construction permit which PRDC has received. The last sentence of § 185, 42 U. S. C. § 2235, expressly so provides, as we shall soon see. And second, there is also no doubt that construction permits like all other licenses can be issued only consistently with the health and safety of the public. But the responsibility for safeguarding that health and safety belongs under the statute to the Commission. And § 104b, especially when read in connec-

tion with the general rule-making power conferred by § 161i (3), 42 U. S. C. § 2201 (i) (3), clearly contemplates that the Commission shall by regulation set forth what the public safety requires as a prerequisite to the issuance of any license or permit under the Act.

The issuance of construction permits is subject to § 185, 42 U. S. C. § 2235. That section provides that

> "All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and latest dates for the completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights thereunder be forfeited, unless upon good cause shown, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this chapter and of the rules and regulations of the Commisson, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this chapter, the Commission shall thereupon issue a license to the applicant. For all other purposes of this chapter, a construction permit is deemed to be a 'license.'"

It is clear from the face of this statute—and all parties agree—that Congress contemplated a step-by-step procedure. First an applicant would have to get a construction permit, then he would have to construct his facility,

and then he would have to ask the Commission to grant him a license to operate the facility. This procedure is described in its general outlines in Marks and Trowbridge, Framework for Atomic Industry, 76–77 (1955). See also Green, The Law of Reactor Safety, 12 Vand. L. Rev. 112, 121–127 (1958). The second step of the procedure, the application for and granting of an operating license, is governed by § 182a, 42 U. S. C. § 2232 (a). That provision reads, in pertinent part:

> "In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications . . . and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material will be in accord with the common defense and security and will provide adequate protection for the health and safety of the public."

It is clear from this provision that before licensing the operation of PRDC's reactor, the AEC will have to make a positive finding that operation of the facility will "provide adequate protection for the health and safety of the public." What is not clear, and what is at the center of the controversy in this case, is whether the Commission must also have made such a finding when it issued PRDC's construction permit. There is nothing on the face of either § 182 or § 185 which tells us what safety findings must be made before this preliminary step is taken. We know, however, from § 104b that some such finding must be made. For enlightenment on the nature of this finding, both parties urge us to examine the Commission's regulations, and accordingly we proceed to do so.

The crucial regulation for our purposes is the Commission's regulation 50.35, 10 CFR § 50.35:

> "Section 50.35. *Extended time for providing technical information.* Where, because of the nature of

> a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, he shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered."

This regulation, obviously, elaborates upon and describes in fuller detail the step-by-step licensing procedure contemplated by §§ 182 and 185. It states, pursuant to the authority conferred by §§ 104b and 161i (3), what safety findings shall be required at each stage of the proceeding. There is general agreement that the second safety finding referred to, "that the final design provides reasonable assurance that the health and safety of the public will not be endangered," comports with the requirements of § 182 concerning the issuance of a license to operate. There is also agreement that the regulation's first required safety finding, "that [the AEC] has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public," is a valid exercise of the rule-making power conferred upon the AEC by statute, and

requires that some finding as to safety of operation be made even before a provisional construction permit is granted. The question is whether that first finding must be backed up with as much conviction as to the safety of the final design of the specific reactor in operation as the second, final finding must be.

We think the great weight of the argument supports the position taken by PRDC and by the Commission, that Reg. 50.35 permits the Commission to defer a definitive safety finding until operation is actually licensed. The words of the regulation themselves certainly lean strongly in that direction. The first finding is to be made, by definition, on the basis of incomplete information, and concerns only the "general type" of reactor proposed. The second finding is phrased unequivocally in terms of "reasonable assurance," while the first speaks more tentatively of "information sufficient to provide reasonable assurance." The Commission, furthermore, had good reason to make this distinction. For nuclear reactors are fast-developing and fast-changing. What is up to date now may not, probably will not, be as acceptable tomorrow. Problems which seem insuperable now may be solved tomorrow, perhaps in the very process of construction itself. We see no reason why we should not accord to the Commission's interpretation of its own regulation and governing statute that respect which is customarily given to a practical administrative construction of a disputed provision. Particularly is this respect due, when the administrative practice at stake "involves a contemporaneous construction of a statute by the men charged with the responsibility of setting its machinery in motion, of making the parts work efficiently and smoothly while they are yet untried and new." *Norwegian Nitrogen Products Co.* v. *United States*, 288 U. S. 294, 315 (1933). And finally, and perhaps demanding particular weight, this construction has time and again been brought to the attention of

the Joint Committee of Congress on Atomic Energy, which under § 202 of the Act, 42 U. S. C. § 2252, has a special duty during each session of Congress "to conduct hearings in either open or executive session for the purpose of receiving information concerning the development, growth, and state of the atomic energy industry," and to oversee the operations of the AEC. See, *e. g.*, Hearings on Development, Growth, and State of the Atomic Energy Industry, 84th Cong., 2d Sess., p. 106 (1956); Hearings on Development, etc., 85th Cong., 2d Sess., pp. 119–121 (1958); Hearings on Development, etc., 86th Cong., 2d Sess., pp. 103–109, 677–678 (1960); Hearings on Development, etc., 87th Cong., 1st Sess., pp. 29–32 (1961); Hearings on Governmental Indemnity for Private Licensees and AEC Contractors Against Reactor Hazards, 84th Cong., 2d Sess., pp. 62–65 (1956); A Study of AEC Procedures and Organization in the Licensing of Reactor Facilities, 85th Cong., 1st Sess., pp. 11–14, 100–108 (Joint Comm. Print 1957). No change in this procedure has ever been suggested by the Committee, although it has on occasion been critical of other aspects of the PRDC proceedings not before us. It may often be shaky business to attribute significance to the inaction of Congress, but under these circumstances, and considering especially the peculiar responsibility and place of the Joint Committee on Atomic Energy in the statutory scheme, we think it fair to read this history as a *de facto* acquiescence in and ratification of the Commission's licensing procedure by Congress. Cf., *e. g.*, *Ivanhoe Irrig. Dist.* v. *McCracken*, 357 U. S. 275, 292–294 (1957); *Brooks* v. *Dewar*, 313 U. S. 354, 360–361 (1941). This same procedure has been used in each of the nine instances in which the Commission has granted a provisional construction permit for a developmental nuclear power reactor, *e. g.*, *Yankee Atomic Elec. Co.*, CPPR–5 (AEC 1957), and we hold that it was properly used in this case.

It is plain that the statute and regulations, as so construed and applied, were complied with fully. The Commission did not, as respondents' argument seems at times to suggest, find merely that the construction of the reactor would present no safety problem. The Commission's opinion and findings clearly were deeply concerned about the prospective safety of operation of the proposed reactor. Admitting that on the basis of the facts before it it was unable to make a definitive finding of safety, the Commission nevertheless found—and respondents do not deny that the finding was supported by substantial evidence—that it had information sufficient to provide reasonable assurance that the general type of reactor proposed could be operated without undue risk to the health and safety of the public. Its Finding 22, which we have quoted, was in the very words of Reg. 50.35, except for the insertion of the phrase, "for the purposes of a provisional construction permit." This phrase was merely declaratory of the nature of the proceeding before the Commission, and in no way denigrated the finding as to safety of operation.

Respondents contend nevertheless that their construction of the statute is compelled by the legislative history. Since the Court of Appeals relied heavily on this history, we have studied it carefully. Two incidents are cited in particular. First, the Joint Committee stated in its report on the bill which became the Atomic Energy Act of 1954, and which when reported contained §§ 182 and 185 in substantially their present shape, that "[s]ection 185 . . . requires the issuance of a license if the construction is carried out in accordance with the terms of the construction permit." S. Rep. No. 1699, 83d Cong., 2d Sess., p. 28 (1954); H. R. Rep. No. 2181, 83d Cong., 2d Sess., p. 28 (1954). The best we can say about this statement, with all deference, is that it must have been inadvertent. Witnesses who appeared before the Joint

Committee at the hearings on the bill had made the very complaint that under the words of the bill as proposed a company might invest large sums in construction of a reactor, and then be denied the right to operate it. This situation, they claimed, was unfair, and would substantially discourage the private investment in the field of atomic power which it was one of the bill's major purposes to stimulate. See Hearings before the Joint Committee on Atomic Energy on the Bill to Amend the Atomic Energy Act of 1946, 83d Cong., 2d Sess., Pt. I., pp. 113, 119 (statement of Paul W. McQuillen, representing the Dow Chemical-Detroit Edison and Associates atomic power development project, predecessors of PRDC); pp. 226–227 (statement of E. H. Dixon, chairman of the Committee on Atomic Power of the Edison Electric Institute and president of Middle-South Utilities, Inc.); p. 417 (statement of the Special Committee on Atomic Energy of the Association of the Bar of the City of New York). In spite of these pleas, however, the bill was unchanged. Industry spokesmen renewed the argument the next year when they sought unsuccessfully to have § 185 amended. Hearings on Development, etc., 84th Cong., 1st Sess., pp. 258, 261 (1955). Even a glance at § 185 suffices to show that issuance of a construction permit does not make automatic the later issuance of a license to operate. For that section sets forth three conditions, in addition to the completion of the construction, which must be met before an operating license is granted: (1) filing of any additional information necessary to bring the application up to date—information which will necessarily in this case include detailed safety data concerning the final design of petitioner's reactor; (2) a finding that the reactor will operate in accordance with the act and regulations—*i. e.*, that the safety and health of the public will be adequately protected—and with the construction per-

mit itself, which is expressly conditioned upon a full investigation and finding of safety before operation is permitted; and (3) the absence of any good cause why the granting of a license to operate would not be in accordance with the Act—*e. g.*, a showing by respondent unions, who will have full rights to appear and contest the issuance of an operating license, that the reactor may not be reasonably safe.

Respondents rely more heavily on another event during the debates on this bill on the floor of the Senate. Senator Humphrey, an opponent of the bill, expressed a desire that it be made clear that "the construction permit is equivalent to a license," and that "the revised section 182 on license application . . . appl[ies] directly to construction permits." 100 Cong. Rec. 11566 (July 26, 1954). Senator Hickenlooper, floor manager of the bill and the ranking Senate member of the Joint Committee on Atomic Energy, indicated that he agreed with this construction of §§ 182 and 185. Senator Humphrey wanted these matters made clear because he feared that otherwise a construction permit could be easily obtained and substantial investment made in construction, and then the Commission would feel obliged, perhaps under pressure, to issue an operating license in order that this investment should not go to waste. The language used in the exchange between Senators Humphrey and Hickenlooper is susceptible, if read broadly and out of context, of the construction which respondents attribute to it, namely, that no § 185 construction permit may be issued unless the Commission has made the same safety-of-operation finding which it must make under § 182a before allowing actual operation. But the context of the exchange makes it clear that no such implication was intended by the participants. Senator Humphrey's statements were made during the consideration of an amendment which he

had himself proposed on July 16. This amendment would have added the following clause to the end of § 185:

> "and no construction permit shall be issued until after the completion of the procedures established by section 182 for the consideration of applications for licenses under this Act."

Upon being assured by Senator Hickenlooper that an earlier amendment which Senator Hickenlooper himself had offered to § 189 took care of the problem, Senator Humphrey withdrew his proposal. This amendment to § 189, which was adopted, was concerned solely with hearings and judicial review. Plainly Senator Humphrey's concern was not with the substantive safety findings necessary to the issuance of a construction permit, but rather with the procedural safeguards with which that issuance should, in his opinion, be surrounded. The reference to the application of § 182 to construction permits was made not with § 182a in mind—that subsection sets out the substantive safety standard for the issuance of an operating license—but rather with a view to the application of § 182b, about which Senator Humphrey particularly asked Senator Hickenlooper during the exchange on the floor referred to, and which merely provides that notice of a license application must be published and given to any appropriate regulatory agencies, a procedural requirement which was fully satisfied in this case. This interpretation of the meaning of Senator Humphrey's remarks is borne out by a statement of Representative Holifield, who, together with Representative Price, had dissented from the favorable report of the Joint Committee, precisely because, *inter alia*, under the bill as reported a construction permit did not have to be preceded by the same *procedures* as an operating license. See S. Rep. No. 1699, 83d Cong., 2d Sess., p. 123 (1954); H. R. Rep. No. 2181, 83d Cong., 2d Sess., p. 123 (1954). Repre-

sentative Price wanted the same amendment added to § 185 which Senator Humphrey proposed, and he characterized this amendment as necessary to ensure "that the same procedural safeguards in the case of licenses be applied to construction permits." 100 Cong. Rec. 10398 (July 19, 1954). We think, therefore, that Senator Humphrey's statement referred only to procedural prerequisites of construction permits, and had nothing to do with the substantive safety considerations which this case involves. If there were any doubt about this matter, the consistent administrative practice, made known to Congress many times and never disturbed by it, would dictate this conclusion.

The Court of Appeals put forward as an alternative basis for its decision the holding that under the law the Commission may not authorize the construction of a reactor near a large population center without "compelling reasons" for doing so, 280 F. 2d, at 651–652, and that no such reasons had been found by the AEC in this case. It is not clear whether respondents have abandoned that contention in this Court, and it is likewise uncertain whether they ever presented it to the Commission, a step which would ordinarily be a prerequisite to its consideration by the Court of Appeals. In any event, the position is without merit. The statute and regulations say nothing about "compelling reasons." Of course Congress (and the Commission too, for that matter) had the problem of safety uppermost in mind, and of course that problem is most acute when a reactor, potentially dangerous, is located near a large city. But the Commission found reasonable assurance, for present purposes, that the reactor could be safely operated at the proposed location, and that is enough to satisfy the requirements of law. The Commission recognized that the site and all its properties are among the most important ingredients of a finding of safety *vel non*. It considered the site along with all

the other relevant data. There is no warrant in the statute for setting aside the Commission's conclusion.

We hold, therefore, that the Court of Appeals erred in setting aside the order of the AEC continuing PRDC's provisional construction permit in effect. We deem it appropriate to add a few words concerning the fears of nuclear disaster which respondents so urgently place before us. The respondents' argument is tantamount to an insistence that the Commission cannot be counted on, when the time comes to make a definitive safety finding, wholly to exclude the consideration that PRDC will have made an enormous investment. The petitioners concede that the Commission is absolutely denied any authority to consider this investment when acting upon an application for a license for operation. PRDC has been on notice long since that it proceeds with construction at its own risk, and that all its funds may go for naught. With its eyes open, PRDC has willingly accepted that risk, however great. No license to operate may be issued to PRDC until a full hazards report has been filed, until the AEC's Advisory Committee on Reactor Safeguards makes a full investigation and public report on safety to the Commission, until the Commission itself, after notice and hearings at which respondents, if they desire, may be heard, has made the safety-of-operation finding required by § 182a and Reg. 50.35, and until the other requirements of § 185 have been met. It may be that an operating license will never be issued. If one is, that will not be the end of the matter. The respondents may have judicial review. Moreover, the Commission's responsibility for supervision of PRDC continues. For, under Reg. 50.57, 10 CFR § 50.57, operation at full power (100,000 electric kilowatts) will not be permitted until several steps of gradually increasing operation have been successfully mastered, with a full public hearing at each step, and no further advance permitted without the AEC's

being fully satisfied that a step-up will meet the high safety standards imposed by law. This is the multi-step scheme which Congress and the Commission have devised to protect the public health and safety. We hold that the actions of the Commission up to now have been within the Congressional authorization. We cannot assume that the Commission will exceed its powers, or that these many safeguards to protect the public interest will not be fully effective.

Accordingly, the judgment is reversed and the cause is remanded to the Court of Appeals for further proceedings consistent with this opinion.

Reversed and remanded.

SUPREME COURT OF THE UNITED STATES

Nos. 315 AND 454.—OCTOBER TERM, 1960.

Power Reactor Development Co., Petitioner, 315 *v.* International Union of Electrical, Radio and Machine Workers, AFL–CIO, et al. United States, et al., Petitioner, 454 *v.* International Union of Electrical, Radio and Machine Workers, AFL–CIO, et al.	On Writs of Certiorari to the United States Court of Appeals for the District of Columbia Circuit.

[June 12, 1961.]

MR. JUSTICE DOUGLAS, with whom MR. JUSTICE BLACK concurs, dissenting.

The only requirement in the Act for a finding that the facilities involved here "will provide adequate protection to the health and safety of the public" is found in § 182 which is headed "License Applications."[1] By the terms of § 185 a construction permit is, apart from the requirements of § 185, "deemed a 'license.'"[2] Section 185 governs applications for construction permits. It has no separate or independent standards for safety, no specific requirement for a finding on "safety." If the facility is finished and will operate "in conformity with" the Act, the license issues "in absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of" the

[1] See Appendix to this opinion.

[2] *Ibid.*

Act. As the Committee Report stated, "Section 185 . . . *requires* the issuance of a license if the construction is carried out in accordance with the terms of the construction permit." [3] In other words the finding on "safety," if it is to be made (as it assuredly must be), must be made at the time the construction permit is issued or not at all.

While in the present case the Commission "finds reasonable assurance in the record, for the purposes of this provisional construction permit" that the facility can be operated "without undue risk to the health and safety of the public," it also finds that "It has not been positively established" that a facility of this character "can be *operated* without a credible possibility of releasing significant quantities of fusion products to the environment." The Commission added that there was "reasonable assurance" before the date when the facility went into operation that research and investigation would definitely establish "whether or not the reactor proposed by the Applicant can be so operated."

Plainly these are not findings that the "safety" standards have been met. They presuppose—contrary to the promise of the Act—that "safety" findings can be made *after construction is finished*. But when that point is reached, when millions have been invested, the momentum is on the side of the applicant not on the side of the public. The momentum is not only generated by the desire to salvage an investment. No agency wants to be the architect of a "white elephant." Congress could design an Act that gave a completed structure that momentum. But it is clear to me it did not do so.

When this measure was before the Senate, Senator Humphrey proposed an amendment that read, "no construction permit shall be issued by the Commission until

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[3] 1 Leg. Hist. 1024. (Emphasis added.)

after completion of the procedures established by Section 182 for the consideration of applications for licenses under this act."[4] That amendment would plainly have made the present findings inadequate, for they leave the issue of "safety" wholly in conjecture and unresolved.

Senator Humphrey explained his amendment as follows:[5]

> "The purpose of the amendment when it was prepared was to make sure that the construction of a facility was not permitted prior to the authorization of a license, because had that been done what it would have amounted to would be getting an investment of a substantial amount of capital, which surely would have been prejudicial in terms of the Commission issuing the license. In other words, if the Commission had granted the construction permit for some form of nuclear reactor, and then the question of a license was not fully resolved, surely there would have been considerable pressure, and justifiably so, for the Commission to have authorized the license once it had authorized the permit for construction.
>
> "The chairman of the committee tells me he has modified certain sections by the committee amendments to the bill, of which at that time I was not aware. The chairman indicates to me that under the terms of the bill, as amended, the construction permit is equivalent to a license. In other words, as I understand, under the bill a construction permit cannot be interpreted in any other way than being equal to or a part of the licensing procedure. Is that correct?"

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[4] 3 Leg. Hist. 3759.

[5] *Ibid.*

His question was answered by Senator Hickenlooper who was in charge of the bill:[6]

> "A license and a construction permit are equivalent. They are the same thing, and one cannot operate until the other is granted.
>
> "The same is true with reference to hearings. Therefore, we believe, and we assure the Senator, that the amendment is not essential to the problem which he is attempting to reach."

Senator Humphrey then asked if § 182 applied "directly to construction permits."[7] Senator Hickenlooper replied "Yes."[8] Senator Humphrey accordingly withdrew his amendment.[9]

This legislative history makes clear that the time when the issue of "safety" must be resolved is before the Commission issues a construction permit. The construction given the Act by the Commission (and today approved) is, with all deference, a light-hearted approach to the most awesome, the most deadly, the most dangerous process that man has ever conceived.[10]

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[6] *Ibid.*

[7] *Ibid.*

[8] *Ibid.*

[9] *Ibid.*

[10] See Biological and Environmental Effects of Nuclear War, Summary-Analysis of Hearings, June 22–26, 1959, Joint Committee on Atomic Energy, 86th Cong., 1st Sess.; Fallout From Nuclear Weapons Tests, Summary-Analysis of Hearings, May 5–8, 1959, Joint Committee on Atomic Energy, 86th Cong., 1st Sess.

APPENDIX.

Section 182a provides in relevant part:

"*License Applications.*—

"a. Each application for a license hereunder shall be in writing and shall specifically state such information as the Commission, by rule or regulation, may determine to be necessary to decide such of the technical and financial qualifications of the applicant, the character of the applicant, the citizenship of the applicant, or any other qualifications of the applicant as the Commission may deem appropriate for the license. In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including information of the amount, kind, and source of special nuclear material required, the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material will be in accord with the common defense and security and will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued."

Section 185 provides:

"*Construction Permits.*—All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and latest dates for the completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights thereunder be forfeited, unless upon good cause, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the

filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the applicant. For all other purposes of this Act, a construction permit is deemed to be a 'license.'"